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ATTORNEY DOCKET NO. 16200.0006U4  
DECLARATION UNDER 37 C.F.R. § 1.132

**DECLARATION UNDER 37 C.F.R. § 1.132 OF DAVID PULLMAN**

Sir:

I, David Pullman, offer the following declarations as evidence in the prosecution of the patent application Serial No. 10/600,006, under the provisions of 37 C.F.R. § 1.132:

1. I received a PhD. (Chemistry) from Harvard University in 1990 and am now an Associate Professor in the Department of Chemistry and Biochemistry at San Diego State University, San Diego, CA, where I have been employed since 1994. My Curriculum Vita is attached hereto as Exhibit A. Other than the current matter, I have no on-going technical, business, or other financial interests in the assignee of the application, Pure Bioscience.
2. My research at San Diego State University regularly involves the use of complex spectroscopic techniques as tools for the analysis of complex chemical systems, in order to establish the existence, and to elucidate the formulae and properties, of chemical species and chemical systems
3. I have read the patent application, Serial No. 10/60,006 (entitled "Disinfectant and Method of Making"), the pending claims and the Office Action dated April 28, 2006. In that Office Action, claims 30 and 36 are rejected as anticipated by an article by Srivastava et al. entitled "Development of Ready to Use Antiseptic Dressings – Part I: Development of Surgical Gauze and Absorbent Cotton by Using In Vitro Laboratory Evaluation Methods," Srivastava, G. C. *et al.*, *Labdev J. Sci. Tech*, Vol. 8-B, No. 4, (1970) (hereinafter "Srivastava"). I have carefully read and understand the disclosure of Srivastava.
4. The Office Action asserts, at page 5, that Applicant's arguments filed February 13, 2006 were unpersuasive because "[a]pplicant argues that the prior art silver citrate is disclosed to be Ag<sub>3</sub> Citrate, so Srivastava's silver citrate must also be such a species. Applicant argues that the Examiner has provided no evidence that

Srivastava's silver citrate contains only one  $\text{Ag}^+$  cation per citrate anion." The Office Action then states:

"Applicant is quite mistaken. Srivastava et al. explicitly disclose 0.5% silver citrate aqueous solution (page 209, right column). Applicant's specification discloses that only 285 ppm of typical prior art silver citrate is soluble in water (page 21, line 15). Srivastava's 0.5% silver citrate solution is about 17.5 times more concentrated than that. Hence this is sufficient evidence that the silver citrate in Srivastava's aqueous solution cannot all be  $\text{Ag}_3\text{Citrate}$ ."

5. I disagree with the Examiner's interpretation of Srivastava's disclosures on several counts further discussed below.
6. First, I disagree that Srivastava necessarily "explicitly disclose[s] 0.5% silver citrate aqueous solution." In my view, it is highly unlikely that Srivastava's solution was truly 0.5% in concentration. The literature value for the solubility of silver citrate in water at room temperature is 0.028%. Boosting the solubility far above this value would be a noteworthy accomplishment, yet Srivastava made no comment or claim of having developed a procedure for substantially increasing the solubility or of having synthesized or procured a new, special form of highly soluble silver citrate. In my opinion, one would logically conclude that the silver citrate Srivastava used in making his solution was the same as conventional, commercially available silver citrate, i.e., trisilver citrate. As for explaining or reconciling the appearance of the concentration, "0.5%," in Srivastava's article, several possible scenarios come to mind: 1) the silver citrate was only partially dissolved, so the actual concentration in solution was less than 0.5%. 2) the silver citrate used in making the solution was a highly hydrated form, so the contribution of the silver citrate to the overall mass was less than 0.5% 3) the silver citrate solution was

above room temperature, so the solubility would be above 0.028% 4) “0.5%” was a typographical error, miscalculation, or related error. Scenario 2 is unlikely because the amount of water in the hydrated silver citrate would have to be extraordinarily high. In any event, the true contribution of silver citrate to the solution would be much less than 0.5%. Scenario 3 is also unlikely: in recent measurements, I have determined that the solubility of silver citrate at 37 °C is below 0.05%. In my opinion, scenario 1 or 4 is the most probable explanation of the appearance of the number “0.05%” in Srivastava’s article. In either scenario, the true concentration in Srivastava’s work would be less than 0.5%.

7. I also note that Srivastava et al. indicate in the abstract that the gauze dipped in the “silver citrate” solution “had good bacteriostatic, but no bactericidal, activity.” If Srivastava’s treated gauze had contained “silver citrate” species at the very high concentrations that would be expected if all of his “0.5% silver citrate” had actually been in solution, I find it surprising that the treated gauze had no bactericidal activity. Other researchers, as well as the Applicant (Figs. 8 and 9 of application), have reported that much lower concentrations of silver citrate show strong bactericidal activity. For example, Salle *et al.* found that silver citrate solutions of 0.002% concentration and lower are strongly bactericidal at 37°C [*J. Bact.* 37: 639 (1939)]. I note that Salle *et al.*’s results are quoted in the monograph, “Disinfection and Sterilization,” by G. Sykes (2<sup>nd</sup> ed., J.B. Lippincott Company, 1965), which in turn is referenced in Srivastava’s article. While the level of bactericidal activity is not a direct measure of silver ion concentration, the lack of bactericidal activity of Srivastava’s treated gauze strongly suggests that Srivastava’s silver citrate solution was not actually 0.5% in concentration.

8. Accordingly, in my opinion, the Examiner's argument based on the alleged high solubility of Srivasta's allegedly "0.5% silver citrate solution," may be based on a misinterpretation or over-interpretation of Srivastava, and the Examiner's assumption that all of Srivastava's "silver citrate" was actually dissolved in the aqueous solution may not be reliable.
9. I have other reasons to doubt the Examiner's assertions that something other than  $\text{Ag}_3\text{Citrate}$  must have been present in Srivastava's sample. It is known by those of ordinary skill in the art that the term "silver citrate" (also known as trisilver citrate) refers to a salt having the formula  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$ , in which three silver ions are bound to one citrate trianion. Trisilver citrate has been disclosed and discussed for decades in the chemical literature, and is available commercially from numerous suppliers.. Applicants have previously submitted three documents to support this proposition, attached as Exhibits B, C, and D, listed below. Two additional references are now included as Exhibits E and F.

Exhibit B: "PubChem Substance Summary" (PubChem Substance ID 679028) for "silver citrate," from the National Center for Biotechnology Information at the National Library of Medicine. This summary contains a list of synonyms for "silver citrate," which includes "trisilver citrate" and the formula  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$ .

Exhibit C: A description of commercially available "silver citrate" (Item #006976 from the online catalogue of Crescent Chemical Company, located at 1324 Motor Parkway, Islandia, New York 11749) indicating that its "silver citrate" has the molecular formula  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$ .

Exhibit D: A description of commercially available “silver citrate” (Product Number 3222 from the online catalogue of ProChem, Inc., located at 826 Roosevelt Rd., Rockford, IL 61109), indicating that the “silver citrate” sold by ProChem has the molecular formula  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$ .

Exhibit E: D.R. Lide, Ed., “CRC Handbook of Chemistry and Physics,” The CRC Press, 73<sup>rd</sup> Edition, p. 4-95, 1992/1993. Item s141 on page 4-95 gives the chemical formula of Silver Citrate as  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$

Exhibit F: P.G. Stecher, Ed. “The Merck Index,” Merck and Co., 8<sup>th</sup> Edition, p. 947, 1968. The description of Silver Citrate gives the chemical formula of Silver Citrate as  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$

10. Exhibits B, C, D, E, and F provide ample evidence that commercially available “silver citrate” actually has the formula “ $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$ ” or “ $\text{Ag}_3\text{Citrate}$ ,” i.e. “trisilver citrate,” and that those of ordinary skill in the art understand that the term “silver citrate” is typically synonymous with the more specific term “trisilver citrate.” Note that Exhibit F (The Merck Index from 1968), which is widely acknowledged as an important scientific reference of chemical compounds, is from the same period of time as Srivastava’s article. Although it is not possible from Srivastava’s terse disclosure to be absolutely certain what form of “silver citrate” he may have actually employed since he provides no such information, in my opinion Exhibits B, C, D, E, and F strongly support Applicant’s position that a person of ordinary skill in the art would understand the term “silver citrate,” as used in the Srivastava article, to be synonymous with the term “trisilver citrate,” or “ $\text{Ag}_3\text{citrate}$ .”

11. In the April 28, 2006, Office Action, on pages 5 and 6 the Examiner alleges:

“As for applicant’s claimed complex,  $\text{Ag}^+\text{CA}^-$ , being present in Srivastava’s aqueous solution, it is the Examiner’s position that such a species must necessarily be present in said aqueous solution because of the dynamics of multiple species in equilibrium and the fact that the solubility of Srivastava’s silver citrate is higher than  $\text{Ag}_3\text{Citrate}$ , as is the case for applicant’s silver citrate.”

As for the presence of citric acid, the Examiner maintains the present claim language requires no more than that which would be present in equilibrium between silver and citrate, forming citric acid species in equilibrium with all the other species, as mentioned by applicant on specification page 22 line 5.

12. In my opinion, these statements by the Examiner are speculative. While it is true that the dynamics of multiple species in equilibrium could lead to the formation of various ions and complexes in solution, in my opinion a pivotal issue is the relative concentration of the various species. Equilibria between multiple species can be driven in one direction or another such that the concentration of some species is significant while the concentration of others is negligible. In the case of silver dihydrogen citrate in 20% citric acid, the applicant developed a new method which effectively drives the equilibria so that significant quantities of  $\text{Ag}^+\text{CA}^-$  are formed (see Exhibits H and I). By contrast, in the case of Srivastava’s silver citrate, I believe the actual concentration of species was sufficiently low that, at best, a negligible amount of  $\text{Ag}^+\text{CA}^-$  was formed. In the mass spectral studies I conducted of a saturated trisilver citrate solution (Exhibit G),  $\text{Ag}^+\text{CA}^-$  was undetectable.
13. To experimentally test the Examiner’s speculations that either  $\text{Ag}^+\text{CA}^-$  or citric was “necessarily” present in Srivastava’s “silver citrate” solutions, I analyzed a saturated aqueous solution of commercially available “trisilver citrate” by

Electrospray Ionization Mass Spectrometry. I also conducted a similar mass spectroscopic analysis of a solution of Applicant's commercial product Axenohl™ (silver dihydrogen citrate in 20% citric acid), which was prepared by the processes disclosed in the present application and is representative of the materials covered by Applicant's pending claims. The electrospray mass spectrometer used in this study was a model LCQ Classic manufactured by the Finnigan Instrument Corporation (now part of Thermo Scientific). The samples were introduced directly into the sample stage of the mass spectrometer by slow infusion using a syringe pump.

14. I obtained commercial samples of anhydrous "silver citrate" (trisilver citrate) from the Crescent Chemical Company (Islandia, NY) and Axenohl™ (silver dihydrogen citrate in 20% citric acid) from Pure Bioscience, Inc., respectively. To prepare the saturated silver citrate solution, I added 0.04 grams of the solid silver citrate to 100 ml of 20°C deionized water. To hasten the dissolution of the solid, I stirred and then ultrasonicated the solution. I then filtered the sample to remove the undissolved solid. To more fully characterize the resulting saturated solution of silver citrate, I measured several physical properties of the solution: At 20 °C, the solution has a pH of ~6, a density of 1.00 g/cc, and an index of refraction of 1.3335 (measured with a Milton Roy refractometer) The pH was measured with a Thermo-Orion 290A+ pH meter and the refractive index with a Milton Roy refractometer. The density was measured by weighing 10.0 ml of solution in a volumetric flask with a balance of 0.1 mg resolution.
15. The technique of Electrospray Ionization Mass Spectrometry allows various species in solution to be identified according to their masses. The electrospray aspect of this method is a means of producing sample ions that can then be mass-analyzed and identified by the mass spectrometer. A sample of the solution is sprayed out of a small orifice into a strong electric field. The resulting aerosol stream consists of small, electrically charged droplets, which then sequentially lose solvent molecules

through evaporation. The remaining species in the shrinking droplets contain individual sample ions or sample ions bound to one or a few solvent molecules. The ions are often protonated versions of neutral molecules (i.e., a positively charged proton,  $H^+$  is bound to a neutral molecule during the ionization process in the mass spectrometer, thus creating a positively charged sample ion). An important feature of this type of mass spectroscopy is that the ionization process is relatively gentle, with the result that weakly-bound complexes present in solution are often not destroyed and can therefore be studied by mass spectroscopy. The ions created are then transported by the electric field into the detection part of the mass spectrometer. The masses and relative abundances of the ions are then determined in the mass spectrometer in atomic mass units per unit of positive charge.

16. Mass Spectroscopy is particularly useful for identifying silver compounds because the element silver is composed of two naturally occurring isotopes of mass 107 and 109, which are approximately equally abundant in nature. Accordingly, mass spectral peaks of silver compounds containing both isotopes typically produce two distinct peaks, separated by two mass units, approximately equal in height. In particular, the expected positions in the mass spectrum of protonated  $Ag^+CA^-$  are 299 and 301.
17. The Electrospray Ionization Mass Spectrum of a saturated water solution of the commercially available "silver citrate" (i.e. trisilver citrate), which has a pH of ~6, a density of 1.00 g/cc, and an index of refraction of 1.3335 at 20 °C, is shown in attached Exhibit G.
18. As can be seen on Exhibit G, the spectrum of the saturated solution of commercially available trisilver citrate gives a forest of peaks, mostly at molecular weights greater than 300 and less than 1000. These peaks are in fact residual background peaks (i.e., noise peaks) from the mass spectrometer. Most



importantly, none of the observed peaks actually contains silver, as the characteristic pairs of silver isotope peaks are absent. In particular, no pair of peaks is observed at 298.9 and 300.9 amu as would be expected for  $\text{Ag}(\text{C}_6\text{H}_8\text{O}_7)^+$  corresponding to  $\text{Ag}^+\text{CA}^-$  (plus an expected extra  $\text{H}^+$  ion added by the spectroscopic ionization technique). Similarly, no cluster of isotopic peaks is observed at about 513 amu, as would be expected for a compound having the formula  $\text{Ag}_3\text{Citrate}$ . Lastly, the saturated solution of commercially available trisilver citrate shows no peaks at all at 193 amu, as would be expected for protonated free citric acid (having the formula  $\text{C}_6\text{H}_8\text{O}_7\text{H}^+$ ). Accordingly, in my opinion, the observed peaks in the highly complex mass spectrum of a saturated solution contain no silver.

19. Overall, from the mass spectral evidence obtained from the saturated solutions of commercially available trisilver citrate, I conclude that nothing in the mass spectra of the saturated solutions of trisilver citrate indicates the presence of  $\text{Ag}^+\text{CA}^-$  or free citric acid. In my opinion, this failure to detect either  $\text{Ag}^+\text{CA}^-$  or free citric acid in the solutions casts additional doubt on the Examiner's contention that  $\text{Ag}^+\text{CA}^-$  or free citric acid would "necessarily" be produced in Srivastava's solutions by "the dynamics of multiple species in equilibrium."
20. In a second set of experiments, I analyzed the Electrospray Ionization Mass Spectrum of a commercially available sample of liquid Axenohl<sup>TM</sup>, which was produced by the electrolysis of silver electrodes in aqueous solutions of citric acid, as disclosed and claimed in the U.S. Patent Application 10/600,006. The Axenohl<sup>TM</sup> solution contains a silver ion concentration of approximately 2500 ppm, and comprises approximately 20% by weight of citric acid in water. To more fully characterize the Axenohl solution, I also measured several physical properties of the solution: At 20 °C, the solution has a pH of 1.7, a density of 1.08 g/cc, and an index of refraction of 1.3594.

21. The Electrospray Ionization Mass Spectrum derived from the sample of liquid Axenohl™ is shown in the attached Exhibits H (a full spectrum) and I (an expanded view of the most relevant portions of the full spectrum).
22. The clearly dominant peaks in the mass spectra occur at masses of 298.9 and 300.9 amu (Exhibits H and I). These peaks are consistent with a chemical species having the formula  $\text{AgC}_6\text{H}_8\text{O}_7$ , i.e. a complex having the formula  $\text{Ag}^+\text{CA}^-$  and/or  $\text{Ag}(\text{C}_6\text{H}_7\text{O}_7)$ . The electrically neutral silver dihydrogen citrate (alternatively termed mono silver citrate) becomes protonated during mass spectral ionization to form the observed  $\text{AgC}_6\text{H}_8\text{O}_7\text{H}^+$  ion
23. In my opinion, the mass spectral presented in Exhibits H and I strongly supports Applicant's contention, and the recitation in claims 30 and 36, that the aqueous Axenohl™ solutions comprise an electrically neutral silver citrate complex having the formula  $\text{Ag}^+\text{CA}^-$  or  $\text{Ag}(\text{C}_6\text{H}_7\text{O}_7)$ , which may be alternatively termed silver dihydrogen citrate. Solutions made from commercially available silver citrate do not have peaks corresponding to  $\text{Ag}^+\text{CA}^-$  and therefore the two compositions are distinct.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements, perjury, and the like so made are punishable by fine or imprisonments, or both, under Section 1001 of Title 18 of the United States Code and that any such willful false statement or perjury may jeopardize the validity of the application or any patent issued thereon.

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David Pullman  
David Pullman

3/27/07  
Date

Exhibit A

**David Pullman**

**Education** Harvard University, Ph.D. in Chemistry  
Princeton University, A.B., Magna Cum Laude

**Professional Experience** **San Diego State University, Department of Chemistry and Biochemistry**  
Assistant Professor of Chemistry, 1994–2000  
Associate Professor of Chemistry, 2000–present  
Adjunct Professor, Computational Science and Research Center, 2005–present  
Massachusetts Institute of Technology, Department of Chemistry  
Postdoctoral Associate and Fellow, 1990–1994

**Honors** Outstanding Faculty Award (for teaching in Chemistry), SDSU, 2002  
Outstanding Faculty Award (for teaching in Chemistry), SDSU, 1999  
Outstanding Faculty Award (for teaching in Chemistry), SDSU, 1998  
Certificate of Teaching Merit, San Diego State University, 1996

**Research Area**

Experimental and computational investigations of the structure and chemical reactivity of surfaces, with emphasis on surfaces and reactions of importance in semiconductor science

**Publications**

C. Zeinalipour-Yazdi and D.P. Pullman, "Correlation of Polarizabilities with Van der Waals Interactions in Pi-Systems," accepted for publication, J. Phys. Chem. A.

D.P. Pullman and K.I. Peterson, "Investigating Intermolecular Interactions via Scanning Tunneling Microscopy: An Experiment for the Physical Chemistry Laboratory," J. Chem. Ed., **81**, 549 (2004).

D.P. Pullman, A.A. Tsekouras, Y.L. Li, J.J. Yang, M.R. Tate, D. Gosálvez-Blanco, K.B. Laughlin, M.T. Schulberg, and S.T. Ceyer, "Reactivity of Fluorinated Si(100)," J. Phys. Chem. B, **105**, 486 (2001).

Steven Chambreau, Monica L. Neuburger, Tom Ho, Brian Funk, and David Pullman, "Low Cost, Mechanically Refrigerated Diffusion Pump Baffle for Ultrahigh Vacuum Chambers," J. Vac. Sci. Technol. A., **18**, 2581 (2000).

M.L. Neuburger and D.P. Pullman, "On the Viability of Atom Abstraction in the Dissociative Chemisorption of O<sub>2</sub> On the Al(111) Surface," J. Chem. Phys., **113**, 1249 (2000).

M.R. Tate, D.P. Pullman, Y.L. Li, D. Gosálvez-Blanco, A.A. Tsekouras, and S.T. Ceyer, "Fluorine Atom Abstraction by Si(100). Model," J. Chem. Phys., **112**, 5190 (2000).

M.R. Tate, D. Gosálvez-Blanco, D.P. Pullman, A.A. Tsekouras, Y.L. Li, J.J. Yang, K.B. Laughlin, S.C. Eckman, M.F. Bertino, and S.T. Ceyer, "Fluorine Atom Abstraction by Si(100). Experimental," J. Chem. Phys., **111**, 3679 (1999).

Y. Li, D.P. Pullman, J. Yang, A.A. Tsekouras, D. Gosálvez, K.B. Laughlin, M.T. Schulberg, D.J. Gladstone, M. McGonigal, and S.T. Ceyer, "A New Mechanism for Dissociative Chemisorption: Atom Abstraction," Phys. Rev. Lett., **74**, 2603 (1995).

D.P. Pullman, B. Friedrich, and D.R. Herschbach, "Collisional Alignment of Molecular Rotation: Simple Models and Trajectory Analysis," J. Phys. Chem. **99**, 7407 (1995).

"A Pocket Model of Seeded Supersonic Expansions," S. DePaul, D.P. Pullman, and B. Friedrich, *J. Phys. Chem.*, **97**, 2167 (1993).

"Alignment and Orientation of Rotationally Cool Molecules," B. Friedrich, D.P. Pullman, and D.R. Herschbach, *J. Phys. Chem.*, **95**, 8118 (1991).

"Facile Alignment of Molecular Rotation in Supersonic Beams," D.P. Pullman, B. Friedrich, and D.R. Herschbach, *J. Chem. Phys.*, **93**, 3224 (1990).

"Alignment of I<sub>2</sub> Molecules Seeded in a Supersonic Beam," D.P. Pullman and D.R. Herschbach, *J. Chem. Phys.*, **90**, 3881 (1989).

"Alignment of I<sub>2</sub> Molecules Seeded in a Supersonic Beam," D.P. Pullman and D.R. Herschbach, *J. Chem. Soc. Faraday Trans. II*, **85**, 1244 (1989).

#### Conference Presentations since 2000

Constantinos Zeinalipour-Yazdi and David P. Pullman (2006), On the Origin of Contrast in STM Images of Graphite, *General Computational Chemistry and Biochemistry Symposium, Western Regional Meeting of the American Chemical Society*: Abstract 369

Constantinos Zeinalipour-Yazdi and David P. Pullman (2006), Correlation of polarizabilities with Van der Waals interactions in  $\pi$ -systems, *General Physical Chemistry Session, Western Regional Meeting of the American Chemical Society*: Abstract 303

K.I. Peterson, D.P. Pullman, W. Lin, and S.E. Novick (2005), Rotational analysis of the van der Waals complex Ar-propane, *Physical Chemistry Symposium, American Chemical Society National Meeting*: Vol. 229. (p. 755).

C. Zeinalipour-Yazdi, E. Loizidou, and D.P. Pullman (2005), Second-order perturbational study of the transformation of hexagonal to rhombohedral graphite, *Colloid and Surface Chemistry Symposium, American Chemical Society National Meeting*: Vol. 229 (p. 676).

C. Zeinalipour-Yazdi, D.P. Pullman, and K.I. Peterson (2005), Origin of contrast in STM images of Graphite, *Colloid and Surface Chemistry Symposium, American Chemical Society National Meeting*: Vol. 229 (p. 702).

C. Zeinalipour-Yazdi, and D.P. Pullman (2005), Plane wave DFT calculations of four layer graphite slab, *SDSU ACSESS for Industry and Curriculum Forum*.

C. Zeinalipour-Yazdi, and D.P. Pullman (2005), Effect of scanning direction and tip-induced perturbations in STM images of graphite, *10<sup>th</sup> Annual Maria Goeppert-Mayer Symposium*.

C. Zeinalipour-Yazdi, J. Gonzalez, K.I. Peterson, and D.P. Pullman (2004), On the Interpretation of Graphite STM Images and Kinetics of Dideuteride Desorption From The Si(100) Surface. *2nd University of California Symposium on Surface Science and Its Applications*: Vol. 2. (p. 20).

C. Zeinalipour-Yazdi, J. Gonzalez, K.I. Peterson, and D.P. Pullman (2003), On the Interpretation of Graphite Images Obtained by STM, *Colloid and Surface Chemistry Symposium, American Chemical Society National Meeting*: Vol. 226. (p. 184).

J.L. Beyer, M.D. Kottke, D.P. Fee, M. Neuburger, and D.P. Pullman (2003), Kinetics of Dihydride Desorption From The Si(100) Surface, *Colloid and Surface Science Symposium, American Chemical Society National Meeting*: Vol. 226. (p. 172).

D.P. Pullman, G. Gidofalvi, D. DeBry, A. Anderson, and B. DeBruler (2001), Role of Oxygen in the Thermal Annealing of Gold Thin Films, *Colloid and Surface Science Symposium, American Chemical Society National Meeting*: Vol. 221. (p. 287).

D.P. Pullman and M.L. Neuburger (2001), On the Viability of Atom Abstraction in the Dissociative Chemisorption of O<sub>2</sub> on the Al(111) Surface, *Colloid and Surface Science Symposium, American Chemical Society National Meeting*: Vol. 221. (p. 190).

D.P. Pullman, M.L. Neuburger, J.L. Beyer, G. Gidofalvi, and S.D. Chambreau (2001), Angular Distribution of Thermally Desorbed D<sub>2</sub> from the Monodeuteride and Dideuteride Phases of Si(100): Implications for the Transition State to Desorption, *Colloid and Surface Science Symposium, American Chemical Society National Meeting*: Vol. 221. (p. 162).

### External Service

External grant reviewer for National Science Foundation and Petroleum Research Corporation

Reviewer for Journal of Chemical Physics, Surface Science, Journal of Vacuum Science and Technology, and Review of Scientific Instruments

### University Service

Undergraduate Advisor and member of Curriculum Committee, SDSU Chemistry, 2004–present

Graduate Advisor and member of Graduate Committee, SDSU Chemistry Department, 1998–2003

Member of University Library Committee, SDSU, 2000–present

Chemistry Department Library and Media Representative, 2001–2004

Member of Analytical Chemistry Faculty Search Committee, SDSU, 1999, 2004, and 2005

Member of College of Sciences ad hoc Research Assigned Committee, 2002

Chair (2001–02) and member of Chemistry Personnel (RTP) Committee, 2000–2002, 2004–present

Member of ad hoc Chemistry Chair Search Committee, 2001

Chair of Physical Chemistry Faculty Search Committee, SDSU, 1998

Member of Executive Committee, SDSU Chemistry Department, 1998–99

2001–2004 Participated in Future Aztecs Day (opened research lab for tours by community)

2005 Arranged and led tour of research and teaching labs in Chemical Sciences Laboratory for Friends of SDSU Library

2001 Consulted with SDSU Physical Plant regarding proper method of calculating fuel-to-water ratio in co-generation plant

### Research Supervision

Graduate Students: Monica L. Neuburger, Steven D. Chambreau, Robert Moision, Jennifer Beyer, Mark Kottke, Constantinos Zeinalipour-Yazdi, David Fee, David Ponte

Undergraduates: Thomas Martin, Steven Hile, Tam Ho, Joseph Salas, Daniel De Bry, Andrew Anderson, Mandy Hoag, Jason Jacintho, Bradley DeBruler, Amanda Howell, Gergely Gidofalvi, Joseph Cortez, Josh Malowney, Jose Gonzalez, James Weese, Christopher McKernan, Robert Tostado, Thomas Styers

Exhibit B –

“PubChem Substance Summary” (PubChem Substance ID 679028) for “silver citrate,”



PubChem

National  
Library  
of Medicine

HOME SEARCH Sitemap

PubMed

Entrez

Structure

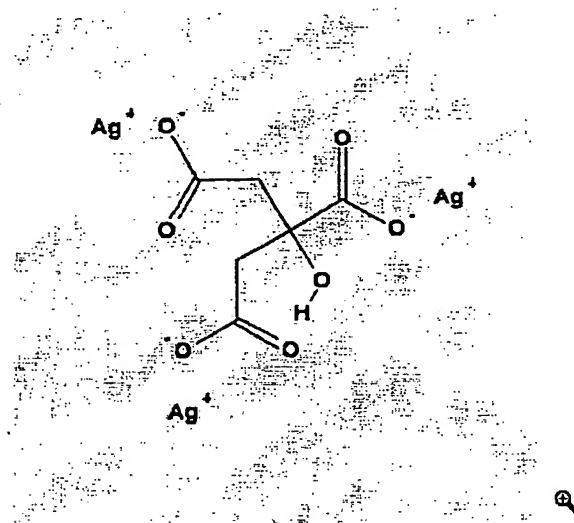
GenBank

Pu

Search PubChem Substance

## Substance Summary:

Compound Displayed



SID: 679028

CID: 101599

Component: 1 Link

NLM Toxicology: Link

Similar Substances: 320 Li

Structure Search

Source: ChemIDplus (000126454)

Synonyms

Properties

Descriptor

Depositor-Supplied Synonyms: (Total: 5)

Silver citrate

Trisilver citrate

EINECS 204-786-8

1,2,3-Propanetricarboxylic acid, 2-hydroxy-, trisilver(1+) salt  
126-45-4

Properties Computed from Structure:

Molecular Weight: 512.704 g/mol



**Molecular Formula:** C<sub>6</sub>H<sub>5</sub>Ag<sub>3</sub>O<sub>7</sub>**Hydrogen Bond Donor Count:** 1**Hydrogen Bond Acceptor Count:** 7**Rotatable Bond Count:** 2**Descriptors Computed from Structure:** **IUPAC Name:** 2-hydroxypropane-1,2,3-tricarboxylate; silver(+1) cation**Canonical SMILES:** C(C(=O)[O-])C(CC(=O)[O-])(C(=O)[O-])O.[Ag+].[Ag+].[Ag+]**InChI:** InChI=1/C6H8O7.3Ag/c7-3(8)1-6(13,5(11)12)2-4(9)10;;;/h13H,1-2H2,(H,7,8)(H,9,10)(H,11,12);;/q;3\*+1/p-3/fC6H5O7.3Ag/q-3;3m 

ASN1	Display	XML	Display	SI
	Save		Save	

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Exhibit C –

A description of commercially available “silver citrate” (Item #006976 from the online catalogue of Crescent Chemical Company, located at 1324 Motor Parkway, Islandia, New York 11749)

About Us

Product Line

New Arrivals

Catalogues

Chemical Links

Periodic Chart

Website Info



## CHEMPUR Elemental Compounds

Item #006976 (25g)  
Silver Citrate, 25g

CAS #126-45-4

Molecular Formula:  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$

Molecular Weight: 512.71

Price: Call For Pricing

Product Size: 25g

Unit of Measure: EA

Note:  $\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$ , F.W. 512.71.

To purchase this product, enter a value greater than 0 here   
and then press the "Add to Order" Button.



Crescent Chemical Company, Inc.  
1324 MOTOR PARKWAY  
ISLANDIA, NEW YORK 11749  
Phone: (631) 348-0333 -Or- (800) 877-3225  
Fax: (631) 348-0913  
Email: CCMail@crescentchemical.com

Exhibit D –


A description of commercially available “silver citrate” (Product Number 3222 from the online catalogue of ProChem, Inc., located at 826 Roosevelt Rd., Rockford, IL 61109



*Our reactions save your money.*

[Home](#) [Catalog](#) [Product Search](#) [Request a Quote](#) [Contact Us](#)

<b>Sr</b> 87.62	<b>Y</b> 88.9058	<b>Zr</b> 91.224
<b>56</b> <b>Ba</b> 137.327	<b>57</b> <b>La</b> 138.9055	<b>58</b> <b>Ce</b> 140.12



### Product Details

**Product Number**

3222

**Formula Wt**

f.w.: 512.707

**Name**

Silver Citrate

**CAS Number**

126-45-4

**Formula**Ag<sub>3</sub>C<sub>6</sub>H<sub>5</sub>O<sub>7</sub>**Info****Purity**

99%

**Quantity**

1 kg

[return](#)

826 Roosevelt Road  
Rockford, IL 61109  
Phone: (815) 398-1788 (800) 795-8788 Fax: (815) 398-1810

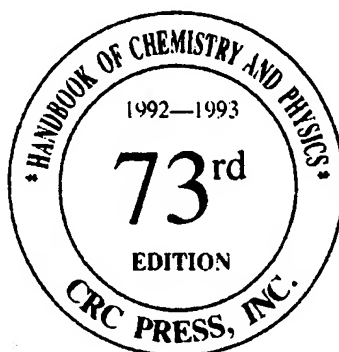
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Exhibit E –

D.R. Lide, Ed., "CRC Handbook of Chemistry and Physics," The CRC Press, 73<sup>rd</sup> Edition, p. 4-95, 1992/1993.

# CRC Handbook of Chemistry and Physics

A Ready-Reference Book of Chemical and Physical Data



Editor-in-Chief

David R. Lide, Ph.D.

Former Director, Standard Reference Data  
National Institute of Standards and Technology



CRC Press

Boca Raton Ann Arbor London Tokyo

# PHYSICAL CONSTANTS OF INORGANIC COMPOUNDS (continued)

No.	Name	Synonyms and Formulas	Mol. wt.	Crystalline form, properties and index of refraction	Density or spec. gravity	Melting point, °C	Boiling point, °C	Solubility, in grams per 100 cc		
								Cold water	Hot water	Other solvents
s105	hydride	Trisilane, trisilane propane. $\text{Si}_3\text{H}_8$	92.32	col liq	liq: 0.743 <sup>g</sup> ; gas: 4.15 g/ $\text{cm}^3$	-117.4	52.9	d	d	d $\text{CCl}_4$
s106	hydride	Tetrasilane, tetrasilane butane. $\text{Si}_4\text{H}_{16}$	122.42	col liq	liq: 0.79 <sup>g</sup> gas 5.48 g/ $\text{cm}^3$	-108	84.3	d		
s107	iodide, tetra-	Tetraiodosilane. $\text{SiI}_4$	535.70	col, cub	4.198	120.5	287.5	d		2.27 $\text{CS}_2$
s108	(di-)iodide, hexa-	Hexaiodosilane. $\text{Si}_2\text{I}_6$	817.60	col, hex		d 250	d	d	d	19 <sup>19</sup> $\text{CS}_2$
s109	nitride	$\text{Si}_3\text{N}_4$	140.28	gray-wh amorph	3.44	1900 press		i	i	s HF
s110	oxide, di-	Nat. cristobalite. $\text{SiO}_2$	60.08	col, cub or tet	2.32	1723 $\pm$ 5	2230 (2590)	i	i	s HF; v al s alk
s111	oxide, di-	Nat. lechatelierite. $\text{SiO}_2$	60.08	col, amorph, vitr.	2.19		2230 (2590)	i	i	s HF; v al s alk
s112	oxide, di-	Nat. opal. $\text{SiO}_2 \cdot n\text{H}_2\text{O}$		col, amorph	2.17-2.20	>1600		i	i	s HF; v al s alk
s113	oxide, di-	Nat. tridymite. $\text{SiO}_2$	60.08	col, rhomb. 1.469, 1.470, 1.471	2.26 <sup>2</sup>	1703	2230 (2590)	i	i	s HF; v al s alk
s114	oxide, di-	Nat. quartz. $\text{SiO}_2$	60.08	col, hex. 1.544, 1.553	2.635-2.660	1610	2230 (2590)	i	i	s HF; v al s alk
s115	oxide, mono-	$\text{SiO}$	44.08	wh, cub	2.13	>1702	1880	i	i	s dil HF + $\text{HNO}_3$
s116	oxychloride	Chlorosiloxane. $\text{Si}_2\text{OCl}_4$	284.89	col liq		28.1 $\pm$ 0.2	137	d	d	s $\text{CS}_2$ , $\text{CCl}_4$
s117	oxyfluoride	$\text{Si}_2\text{OF}_6$	186.16	col, gas	1.358 liq	-47.8 $\pm$ 0.5	-23.3	d	d	d alk
s118	sulfide, di-	$\text{SiS}_2$	92.21	wh need, rhomb	2.02	subl 1090	white heat	d	d	d al, liq $\text{NH}_3$ ; s dil alk; i bz
s119	sulfide, mono-	$\text{SiS}$	60.15	yel need	1.853 <sup>15</sup>	subl 940 <sup>20</sup>		d	d	d al, alk
s120	thiocyanate	$\text{Si}(\text{CNS})_4$	260.40	wh, rhomb need	1.409 <sup>20</sup>	143.8	314.2	d		d al, s, alk; i eth. $\text{CS}_2$ , $\text{CHCl}_3$
s121	Silicotungstic acid	$\text{H}_4[\text{Si}(\text{W}_3\text{O}_{10})_4] \cdot 26\text{H}_2\text{O}$	3346.69	wh-si yel cr, deliq				v s	v s	v s al
s122	Silicic oxide	Dissiloxane $(\text{SiH}_3)_2\text{O}$	78.22	col gas	gas: 3.491 g/ $\text{cm}^3$ liq: 0.881 <sup>18</sup>	-144	-15.2	v s	sl d	
s123	Silicene, (di-), oxide	$[\text{H}(\text{O})\text{Si}]_2\text{O}$	106.19	wh volum sub		expl co 300		sl s		s, d HF; d al
s124	Silver	Ag	107.8682 $\pm$ 2	wh met, cub 0.34	10.5 <sup>20</sup>	961.93	2212	i	i	s $\text{HNO}_3$ , h $\text{H}_2\text{SO}_4$ , KCN; i alk
s125	acetate	$\text{AgC}_2\text{H}_3\text{O}_2$	166.91	wh pl.	3.259 <sup>15</sup>	d		1.02 <sup>20</sup>	2.52 <sup>20</sup>	s dil $\text{HNO}_3$
s126	acrylide	$\text{Ag}_2\text{C}_2$	239.76	wh ppt		expl		i		s al; sl s al
s127	orthocarbonate	$\text{Ag}_3\text{AsO}_4$	462.52	dk red, cub	6.657 <sup>25</sup>	d		0.00085 <sup>20</sup>		s $\text{NH}_4\text{OH}$ , ac s
s128	orthocarbonate	$\text{Ag}_3\text{AsO}_3$	446.52	yel, powd		d 150		0.00115 <sup>20</sup>		s ac s, $\text{NH}_4\text{OH}$ , $\text{HNO}_3$ ; i al
s129	azide	$\text{AgN}_3$	149.89	wh rhomb pr, expl		252	297	i	0.01 <sup>100</sup>	s KCN, dil $\text{HNO}_3$ ; sl s $\text{NH}_4\text{OH}$
s130	hexazate	$\text{AgC}_6\text{H}_5\text{O}_2$	228.98	wh powd				0.262 <sup>25</sup>	s	0.017 al
s131	tetraborate	$\text{Ag}_2\text{B}_4\text{O}_7 \cdot 2\text{H}_2\text{O}$	407.00	wh cr.				sl s		s s
s132	bromate	$\text{AgBrO}_3$	235.77	col, tet, 1.874, 1.920	5.206	d		0.196 <sup>25</sup>	1.33 <sup>30</sup>	s $\text{NH}_4\text{OH}$ ; al s $\text{HNO}_3$
s133	bromide	Bromyrite: $\text{AgBr}$	187.77	pa yel. 2.253	6.473 <sup>25</sup>	432	d >1300	8.4 $\times 10^{-6}$	0.00037 <sup>100</sup>	s KCN, $\text{Na}_2\text{S}_2\text{O}_3$ , $\text{NaCl}$ sol; sl s $\text{NH}_4\text{OH}$ ; i al
s134	carbonate	$\text{Ag}_2\text{CO}_3$	275.75	yel powd	6.077	d 218		0.0032 <sup>20</sup>	0.05 <sup>100</sup>	s $\text{NH}_4\text{OH}$ ; i al
s135	chlorate	$\text{AgClO}_3$	191.32	wh, tet	4.430 <sup>20</sup>	230	d 270	10 <sup>15</sup>	50 <sup>60</sup>	sl s al
s136	perchlorate	$\text{AgClO}_4$	207.32	wh, cr, deliq	2.806 <sup>25</sup>	d 486		557 <sup>25</sup>		s al; 101 coh; 5.28 bz
s137	chloride	Nat. cerargyrite. $\text{AgCl}$	143.32	wh, cub, 2.071	5.56	455	1550	0.000089 <sup>10</sup>	0.0021 <sup>100</sup>	s $\text{NH}_4\text{OH}$ , $\text{Na}_2\text{S}_2\text{O}_3$ , KCN
s138	chlorite	$\text{AgClO}_2$	175.32	yel cr.		105 expl		0.45 <sup>25</sup>	2.13 <sup>100</sup>	s $\text{NH}_4\text{OH}$ , KCN
s139	chromate	$\text{Ag}_2\text{CrO}_4$	331.73	red, monoc	5.625	d		0.0014 <sup>6</sup>	0.008 <sup>70</sup>	s $\text{NH}_4\text{OH}$ , KCN
s140	dichromate	$\text{Ag}_2\text{Cr}_2\text{O}_7$	431.72	red, tric	4.770	d		0.0023 <sup>15</sup>		s s, $\text{NH}_4\text{OH}$ , KCN
s141	citrate	$\text{Ag}_3\text{C}_6\text{H}_5\text{O}_7$	512.71	wh need		d		0.028 <sup>18</sup>	sl s	s s, $\text{NH}_4\text{OH}$ , KCN, $\text{Na}_2\text{S}_2\text{O}_3$
s142	cyanate	$\text{AgOCN}$	149.89	col	4.00	d		sl s	s	s KCN, $\text{HNO}_3$ , $\text{NH}_4\text{OH}$
s143	cyanide	$\text{AgCN}$	133.89	wh, hex	3.95	d 320		0.000023 <sup>20</sup>		s $\text{HNO}_3$ , $\text{NH}_4\text{OH}$ , KCN, $\text{Na}_2\text{S}_2\text{O}_3$
s144	ferrocyanide	$\text{Ag}_3\text{Fe}(\text{CN})_6$	535.56					0.000066 <sup>20</sup>		i al; s $\text{NH}_4\text{OH}$ , h $(\text{NH}_4)_2\text{CO}_3$
s145	ferrocyanide	$\text{Ag}_6\text{Fe}(\text{CN})_6 \cdot \text{H}_2\text{O}$	661.44	wh				i		s KCN; i s, $\text{NH}_4$ salts, $\text{NH}_4\text{OH}$
s146	fluogallate	$\text{Ag}_3(\text{GaF}_6) \cdot 10\text{H}_2\text{O}$	687.47	col, orthorhomb	2.90			v s		i al
s147	fluoride	$\text{AgF}$	126.87	yel, cub, deliq	5.852 <sup>15,3</sup>	435	ca 1159	182 <sup>15,3</sup>	205 <sup>108</sup>	sl s $\text{NH}_4\text{OH}$
s148	fluoride, di-	$\text{AgF}_2$	145.87	brn, rhomb	4.57-4.58	690	d 700	d	d	
s149	(di-)fluoride	$\text{Ag}_2\text{F}_2$	234.73	yel, hex	8.57	d 90		d		
s150	fluosulfate	$\text{Ag}_2\text{SF}_6 \cdot 4\text{H}_2\text{O}$	429.87	wh powd or col cr, deliq		>100	d	v s		
s151	fulminate	$\text{Ag}_2\text{C}_3\text{N}_2\text{O}_2$	299.77	need		expl		0.075 <sup>15</sup>		s $\text{HNO}_3$ ; s $\text{NH}_4\text{OH}$
s152	iodate	$\text{AgIO}_3$	282.77	col, rhomb	5.525 <sup>14,5</sup>	>200	d	0.03 <sup>18</sup>	0.019 <sup>60</sup>	s $\text{HNO}_3$ , $\text{NH}_4\text{OH}$ , KI
s153	periodate	$\text{AgIO}_4$	298.77	or yel, tetrag	5.57	d 180		d		s $\text{HNO}_3$
s154	iodide(a)	micronite AgI	234.77	yo tet 2.02 $\pm$ .02	5.683 <sup>20</sup>	tr 146 to $\beta$		2.8 $\times 10^{-7,25}$	2.5 $\times 10^{-6,60}$	s KCN, $\text{Na}_2\text{S}_2\text{O}_3$ , KI; sl s $\text{NH}_4\text{OH}$
s155	iodide (b)	iodydite AgI	234.77	pa ye hex	6.010 <sup>14,6</sup>	558	1506			
s156	iodomercurate (a)	$\text{Ag}_2\text{HgI}_4$	923.94	yel, tetrag	6.02	tr to $\beta$ 30.7		i		s KI, KCN; i dil s
s157	iodomercurate (b)	$\text{Ag}_2\text{HgI}_4$	923.94	red, cub	5.90	d 158		i		s KI, KCN; i dil s



Exhibit F –

P.G. Stecher, Ed. "The Merck Index," Merck and Co., 8<sup>th</sup> Edition, p. 947, 1968

# THE MERCK INDEX

AN ENCYCLOPEDIA OF  
CHEMICALS AND DRUGS

EIGHTH EDITION

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RAHWAY, N. J., U. S. A.

1968

to form superphosphate, based on the reaction  $2\text{H}_2\text{SiF}_6 + \text{SiO}_2 \rightarrow 3\text{SiF}_4 + 2\text{H}_2\text{O}$ : Moistad, U.S. pat. 2,833,828 (1958 to W. R. Grace & Co.).

Colorless gas; very pungent odor similar to that of hydrogen chloride. Forms heavy clouds with moist air. Dec by water into silicic acid and HF. Sublimes  $-95.7^\circ$ ; mp  $-90.2^\circ$  (under pressure);  $d_4^{25}$  1.590. Critical temp  $-1.5^\circ$ ; critical pressure 50 atm.

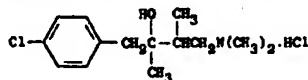
Human Toxicity: See Fluorine.

**Silicotungstic Acid. Tungstosilicic acid.**  $\text{SiO}_2 \cdot 12\text{WO}_3 \cdot 26\text{H}_2\text{O}$ ; mol wt 3310.83. Anhydr cpd 85.85%,  $\text{H}_2\text{O}$  14.15%,  $\text{SiO}_2$  1.81%, W 66.63%, Si 0.85%,  $\text{WO}_3$  84.04%.

White to slightly yellow, deliquescent crystals. Very sol in water, alcohol. Keep tightly closed.

USE: Preparing heavy solns for separating minerals (20 g + 4 ml water has a d 2.74); as a mordant for basic aniline dyes; as a reagent for pptn and determination of alkaloids.

**Silomat.** *p*-Chloro- $\alpha$ -(2-(dimethylamino)-1-methyl-1- $\alpha$ -methylphenethyl alcohol hydrochloride; 2-(*p*-chlorobenzyl)-3-dimethylaminomethyl-2-butanol hydrochloride; 1-*p*-chlorophenyl-2,3-dimethyl-4-dimethylamino-2-butanol hydrochloride; 1-(4-chlorophenyl)-2,3-dimethyl-2-butanol hydrochloride; KAT 256.  $\text{C}_{16}\text{H}_{25}\text{ClNO} \cdot \text{HCl}$ ; mol wt 292.25.  $\text{C}_{16}\text{H}_{25}\text{Cl}_2\text{NO}$ ; C 57.54%, H 7.93%, Cl 24.26%, N 4.79%, O 5.47%. Prep: Brit. pat. 898,010 (1962 to Dr. Karl Thomae GmbH).



Minute crystals, mp  $169-170^\circ$  (free base, bp<sub>15</sub>  $179-181^\circ$ ). Slightly bitter, acidic taste. Numbs the tongue. Soluble in water. LD<sub>50</sub> orally in mice: 600 mg/kg.

MED USE: Antitussive.

**Silver.** Ag; at. wt 107.870; at. no. 47; valence, 1 and 2. Isotopes:  $^{107}$  (52.5%);  $^{109}$  (47.5%). Found native or associated with copper, gold, lead; the principal ores are argentite, kerargyrite, horn silver, proustite, pyrargyrite. Constitutes  $1 \times 10^{-4}\%$  of the crust of the earth. Extraction from the ores: Percy et al., cited by Mellor, *A Comprehensive Treatise on Inorganic and Theoretical Chemistry* 3, 301 (1928). Comprehensive monograph: A. Butta, C. D. Cox, Eds., "Silver, Its Economics, Extraction, Use" (Van Nostrand, Princeton, 1967), 480 pp.

White metal, face-centered cubic structure. More malleable and ductile than any other metal except gold; excellent conductor of heat and electricity. mp  $960.5^\circ$ ; bp about  $2000^\circ$ ;  $d^{18}$  10.49. Not attacked by water or atmospheric oxygen; blackened by ozone, by hydrogen sulfide, by sulfur. Insoluble in most acids; readily sol in dil nitric acid, in hot concd sulfuric acid; superficially attacked by hydrochloric acid. Soluble in fused alkali hydroxides in presence of air; sol in fused alkali peroxides; sol in alkali cyanides in presence of air or oxygen. Most silver salts are light-sensitive.

USE: For coinage, most frequently alloyed with copper or gold; for manuf tableware, mirrors, jewelry, ornaments; for electroplating; for making vessels and apparatus used in manuf medicinal chemicals, in processing foods and beverages, in handling organic acids; as catalyst in hydrogenation and oxidation processes; as ingredient of dental alloys.

Caution: Inhalation of dust should be avoided.

MED USE: Has been used for purification of drinking water (about 1 part in 20 million). Human Toxicity: Does not cause serious toxic manifestations, but prolonged absorption of silver compds can lead to grayish blue discoloration of skin, known as argyria or argyrosis. Many silver salts are irritating to skin, mucous membranes.

**Silver Acetate.**  $\text{CH}_3\text{COOAg}$ ; mol wt 166.92.  $\text{C}_2\text{H}_3\text{AgO}_2$ ; C 14.39%, H 1.81%, Ag 64.63%, O 19.17%, acetic acid 35.98%.

White to slightly grayish, lustrous needles or cryst powder. d 3.26. Soluble in 100 parts of cold water, 35 parts of boiling water; freely sol in dil nitric acid. Protect from light.

**Silver Arsenite.**  $\text{Ag}_3\text{AsO}_3$ ; mol wt 446.55. Ag 72.48%,  $\text{As}_2\text{O}_3$  22.15%, As 16.78%, O 10.73%.

Yellow powder, sensitive to light. Poisonous! Dec at  $150^\circ$ . Insoluble in water; readily dissolved by dil nitric acid or ammonia.

**Silver Bromate.**  $\text{AgBrO}_3$ ; mol wt 235.80. Ag 45.75%, Br 33.89%, O 20.36%.

White powder; dec by heat. d 5.2. Soluble in 595 parts water; freely sol in ammonia, sparingly in dil nitric acid. Protect from contact with organic matter.

**Silver Bromide.**  $\text{AgBr}$ ; mol wt 187.80. Ag 57.45%, Br 42.55%.

Yellowish, odorless powder; darkens on exposure to light. d 6.47; mp  $432^\circ$ . Insoluble in water, alcohol, or most acids; slightly sol in dil ammonia, but moderately sol in concd ammonia. One liter of 10% ammonia dissolves 3.3 g at  $12^\circ$ ; sol in solns of alkali cyanides, sparingly sol in soln of thiosulfates or thiosulfates; soluble in 220 parts saturated NaCl, in 35 parts saturated KBr solns; slightly in ammonium carbonate soln. Protect from light.

USE: In photography.

MED USE: Formerly as ingredient of Argentol (16% of silver bromide) used as topical astringent, antiseptic.

**Silver Carbonate.**  $\text{Ag}_2\text{CO}_3$ ; mol wt 275.77. C 4.36%, Ag 78.24%, O 17.41%,  $\text{CO}_2$  15.96%.

Light yellow powder when freshly pptd, but becomes darker on drying and on exposure to light. Dec at about  $220^\circ$  into  $\text{Ag}_2\text{O}$  and  $\text{CO}_2$  and at higher temp into metal Ag. d 6.08. Soluble in 30,000 parts cold water, 2000 parts boiling water; readily sol in dil nitric acid, ammonia, or alkali cyanides. Protect from light.

**Silver Chlorate.** Argentous chlorate.  $\text{AgClO}_3$ ; mol wt 191.34. Ag 56.38%, Cl 18.53%, O 25.09%. Prep'd according to the eq  $\text{AgNO}_3 + \text{NaClO}_3 \rightarrow \text{AgClO}_3 + \text{NaNO}_3$ : Nicholson, Holley, Jr., *Inorg. Syn.* 2, 4 (1946).

White, tetragonal crystals.  $d_4^{25}$  4.430. mp  $230^\circ$ , dec  $270^\circ$  forming silver chloride and oxygen. Solubility in water at  $15^\circ$  = 10 g/100 ml; at  $27^\circ$  = 20 g/100 ml; at  $80^\circ$  = 50 g/100 ml. Slightly sol in alc. Darkens upon exposure to light because of slow decompn. Keep away from light, organic vapors, and oxidizable substances.

USE: In organic synthesis as an effective oxidizing agent for certain organic compds.

**Silver Chloride.**  $\text{AgCl}$ ; mol wt 143.34. Ag 75.26%, Cl 24.74%.

White powder; darkens on exposure to light. d 5.56; mp  $455^\circ$ ; bp  $1550^\circ$ . Insoluble in water, alcohol, or dil acids. One liter of water dissolves only 2 mg; hydrochloric acid increases its soly; it is sol in 250 parts of concd HCl, in 13 parts of 10% ammonia; more sol in stronger ammonia and also at higher temps. It is sol in solns of alkali cyanides, thiosulfates, ammonium carbonates; appreciably sol in concd aq solns of ammonium chloride, mercuric nitrate, and silver nitrate. The freshly pptd chloride dissolves more readily than the dried precipitate. Protect from light.

USE: In silver plating, in making antiseptic silver preps.

Human Toxicity: See Silver.

**Silver Chlorite.**  $\text{AgClO}_2$ ; mol wt 175.34. Ag 61.53%, Cl 20.22%, O 18.25%.

Yellow crystals. Explodes at  $103^\circ$ . Solubility in water at  $25^\circ$  = 0.45 g/100 ml; at  $100^\circ$  = 2.13 g/100 ml.

**Silver Chromate(VI).**  $\text{Ag}_2\text{CrO}_4$ ; mol wt 331.77. Ag 65.03%,  $\text{CrO}_3$  30.14%, O 19.29%, Cr 15.68%.

Dark brownish-red, cryst powder. Soluble in 3450 parts water, in nitric acid and ammonia.

**Silver Citrate.** Itrol; Silberol.  $\text{C}_6\text{H}_5\text{Ag}_3\text{O}_7$ ; mol wt 512.74. Anhydr citric acid 37.47%, C 14.05%, H 0.98%, Ag 63.12%, O 21.84%.

White, odorless, heavy, cryst powder; darkens in light. Soluble in 3300 parts water, more soluble in boiling water; readily soluble in dil  $\text{HNO}_3$ , ammonia. Protect from light.

MED USE: Has been used as antiseptic dusting powder for wounds.

**Silver Cyanide.**  $\text{AgCN}$ ; mol wt 133.90. C 8.97%, Ag 80.57%, N 10.46%, CN 19.43%.

White or grayish, odorless powder; stable in dry air; darkens on exposure to light; dec at  $320^\circ$ . Poisonous! d 3.95. Insoluble in water, alcohol, or dil acids; sol in alkali cyanides and in boiling concd nitric acid; converted by dil-HCl into hydrocyanic acid and silver chloride; sparingly sol in dil, more in concd ammonia. Protect from light.

USE: For silver plating; formerly used for extemporaneous prep of dil hydrocyanic acid by treatment with hydrochloric acid.

Exhibit G – Electrospray Mass spectrum of saturated aqueous solution of trisilver citrate ( $\text{Ag}_3\text{Citrate}$ )

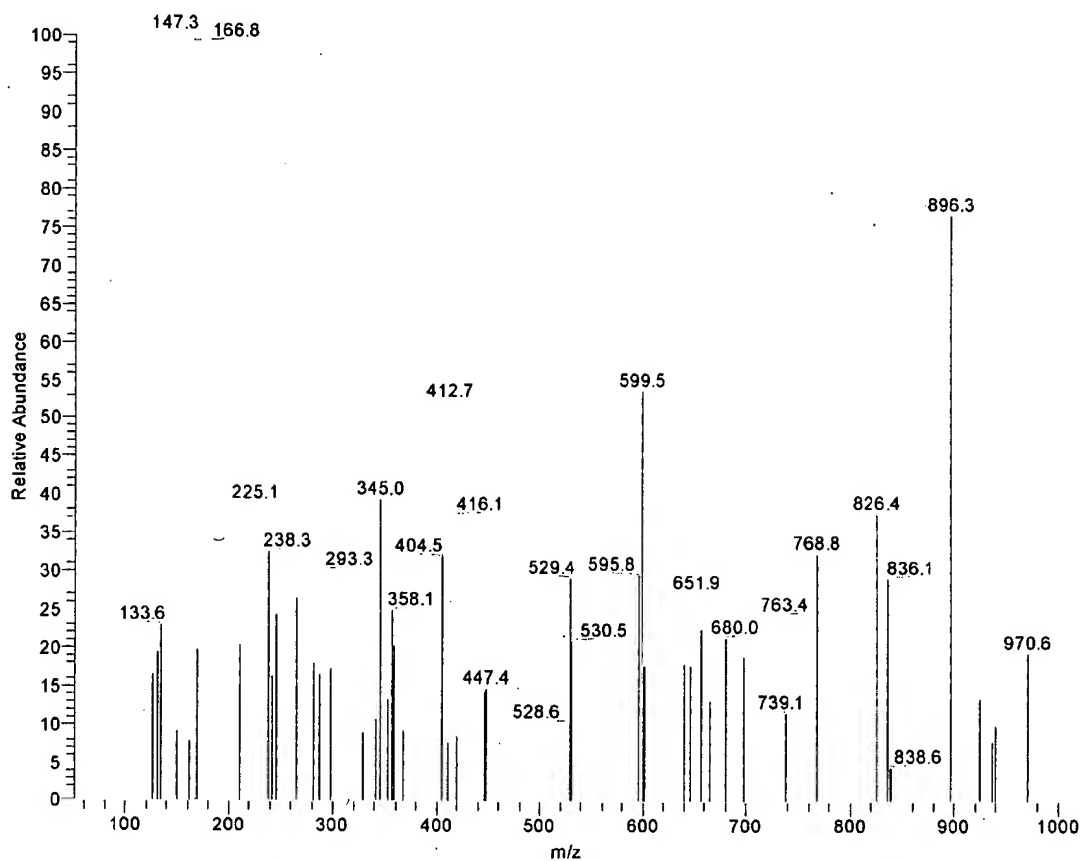


Exhibit H - Electrospray Mass spectrum of commercially available solution of Axenohl™

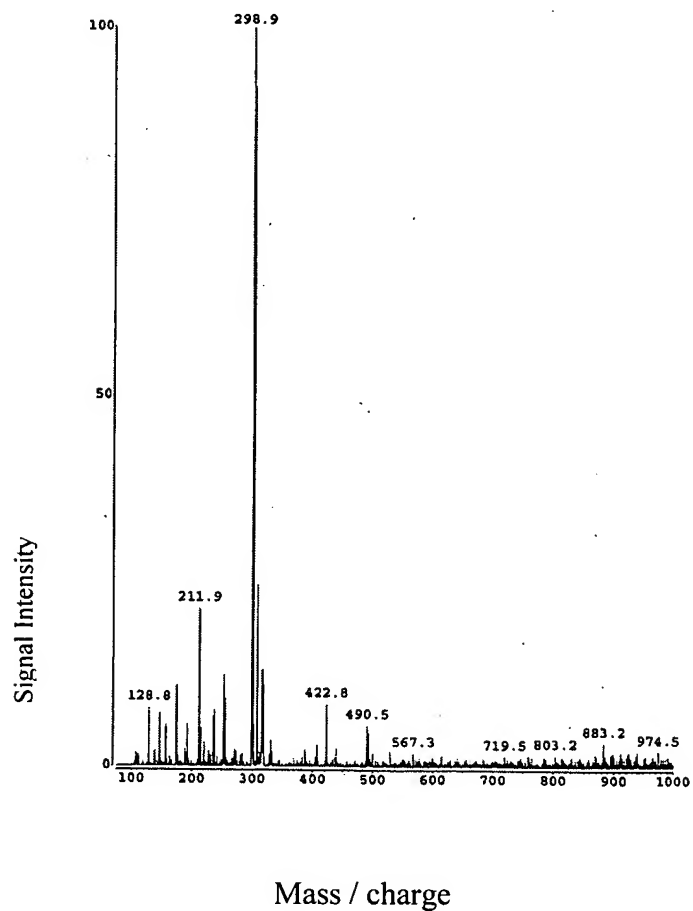
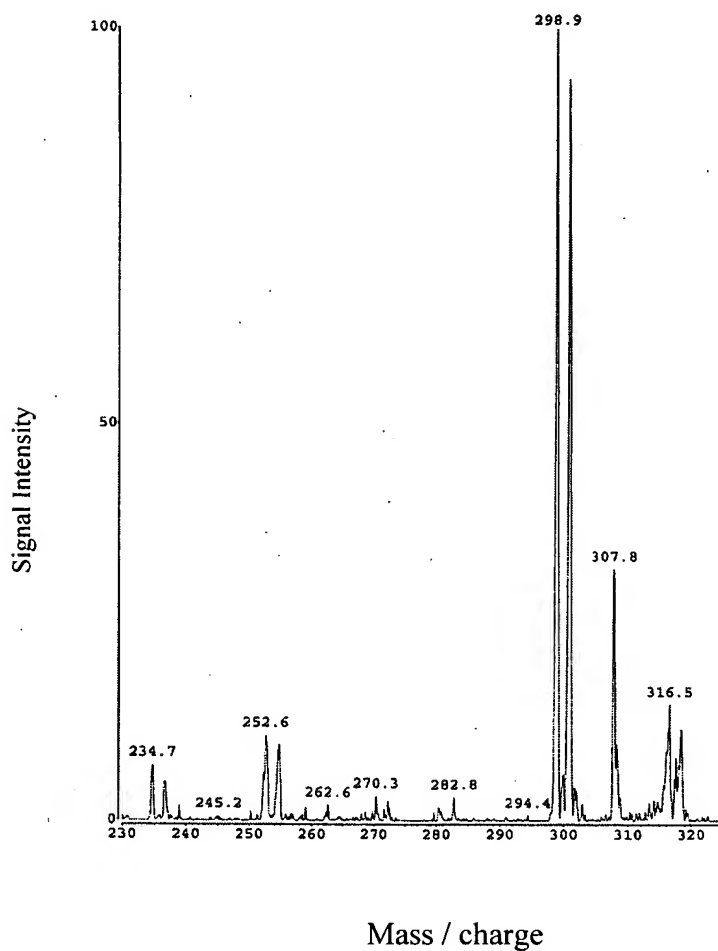


Exhibit I – Expanded View of Electrospray Mass spectrum of commercially available solution of Axenoh<sup>TM</sup>



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